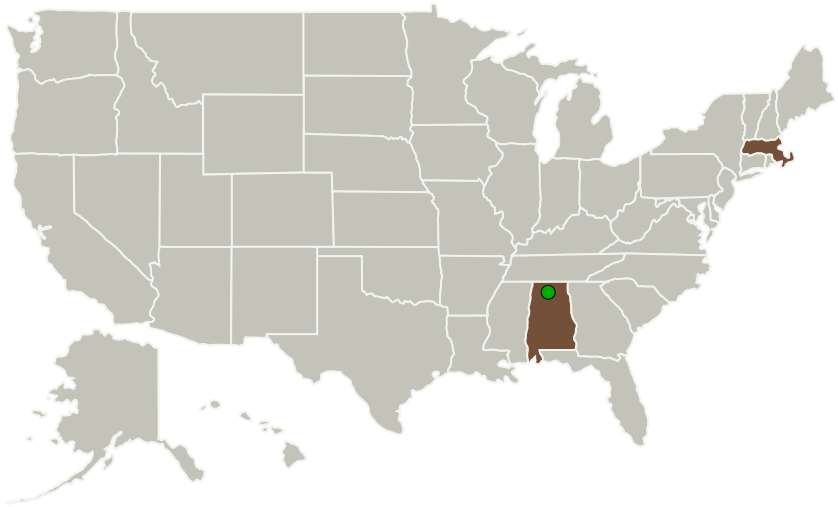
In-situ Sensing for Multi-Functional Structures, Phase I

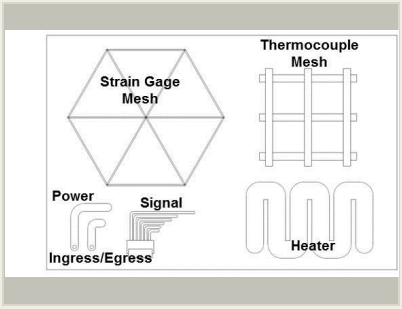
Completed Technology Project (2015 - 2015)

Project Introduction

Aurora has developed a method to directly embed conductive fibers and dielectric layers into a carbon fiber-reinforced polymer (CFRP) structure. To date we've been using this method to embed wiring harnesses and heaters into structures. The proposed innovation leverages our success with embedded wiring, to embed strain gages and thermocouples. The resulting innovation yields CFRP structures with multiple functionalities: 1) transmitting electrical power 2) transmitting electrical signals 3) heating 4) sensing strain due to loading 5) sensing residual strain due to manufacturing 6) sensing crack propagation 7) sensing temperature The innovation is enabled by a novel combination of materials within a shared manufacturing process. The material combination makes use of common carbon fibers that are conductive and demonstrate peizoresitive properties. By layering and arranging these materials in a novel manner, the functionalities listed above can be realized. Given that these sensing materials are in-situ (i.e. the materials are all fiber based and share a common matrix material) structural integrity is not compromised and the sensors are more likely to survive a lifetime of cyclic loading. Additionally, because the sensory materials and conductors are all fiber-based, automated manufacturing techniques (e.g. automated fiber placement) can be utilized to reduce manufacturing costs. The embedded technologies, in combination with Aurora's self- aware aircraft tools, promise to reduce weight, increase performance, and life expectancy of aircraft.

Primary U.S. Work Locations and Key Partners





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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Small Business Innovation Research/Small Business Tech Transfer

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Organizations Performing Work	Role	Type	Location
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	Massachusetts

Project Transitions

June 2015: Project Start

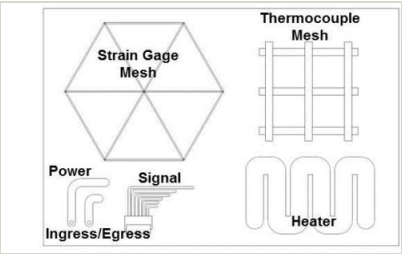
December 2015: Closed out

Closeout Summary: In-situ Sensing for Multi-Functional Structures, Phase I Project Image

Closeout Documentation:

- Final Summary Chart Image*(https://techport.nasa.gov/file/139109)*

Images



Briefing Chart Image
In-situ Sensing for Multi-Functional Structures, Phase I
(https://techport.nasa.gov/image/131561)

Project Management

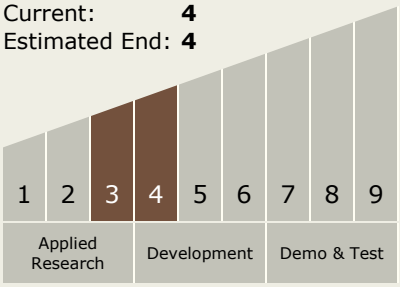
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Dan Campbell

Technology Maturity (TRL)

Start: **3**
Current: **4**
Estimated End: **4**



Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.2 Structures
    - TX12.2.3 Reliability and Sustainment

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System